

Section D – The Specification

A. PROTECTIVE RELAY TEST SET SPECIFICATIONS

1. GENERAL

The requirements set forth hereinafter describe one protective relay test set, hereinafter referred to as "the set", and shall apply to each protective relay test set furnished under this specification.

The set shall provide basic functional testing of both electro-mechanical and microprocessor-based, generation, transmission and distribution relays. It shall be capable of being upgraded in hardware instrumentation, features/options and software, which provides for customization to meet various field and laboratory applications. The system shall be formed from independently operating components which provide full testing capability; voltage & current sources, timer/sensing, breaker simulation, logic outputs and logic inputs for single phase relaying. The independent components shall be capable of interfacing to form a system for more complex applications. All amplifiers shall be direct coupled and at power ratings to test high burden ground, directional ground (IRD) and differential E/M relays as well as full panels of relays. In order to achieve maximum power to test relays, test system shall be provided with multiple current and voltage ranges. Control of the parametric values shall come from individual controls. The system shall be optionally capable of providing steady state, dynamic and transient testing from a software system. **The system shall not exceed one instrument when full three phase high power currents are required. The weight cannot exceed 50 lbs.**

The set shall provide variable voltage and current, precise phase angle control, wide frequency range, integral digital timer, and battery simulator. The set shall provide a three-phase wye connected voltage and three-phase wye connected current simultaneously, and two three-phase wye current sources simultaneously.

The set shall incorporate digital readouts of each applied source quantity. The display shall indicate both magnitude and phase angle of all applied/source quantities simultaneously. The set shall incorporate PC controls for varying the source output parameters, when in manual mode. The set shall accommodate a PC based automated testing program.

The set shall be capable of testing all types of impedance relays, phase comparison relays, directional overcurrent relays, overcurrent relays, over and under-voltage relays, differential relays, high impedance bus differential relays, over and under frequency relays, and voltage or current negative sequence filter networks.

The set shall be modular in design; capable of providing a single three-phase voltage and current test system, as well as, three single-phase voltage and current test system.

The supplier shall be ISO-9001 Registered.
The set and software shall be Y2K compliant.

2. PROTECTIVE RELAY TEST SET:

The set shall be comprised of Direct Coupled Power System Simulators of stand-alone minimized modular design.

A. GENERAL SPECIFICATIONS:

- (1) Output Voltage: The set shall be capable of providing independently varying voltage sources capable of meeting or exceeding the detailed specifications given in Subarticle 2b of this division. Note all AC values are given in RMS values.
- (2) Output Current: The set shall be capable of providing independently varying current sources capable of meeting or exceeding the detailed specifications given in Subarticle 2b of this division. Note all AC values are given in RMS values.
- (3) Digital Timer: The set shall incorporate eight independent timer units capable of monitoring the status of relay contacts, SCR operation, or presence of AC or DC voltage. Note all AC values are given in RMS values.
- (4) Transient Rating: The set shall be capable of outputting the transient output source, for a maximum of 1½ seconds, with no less than a ½ second delay and no more than a one-second delay between transient requests.
- (5) Monitoring Circuit: The set shall incorporate monitoring circuitry capable of giving an audible and visual indication of contact opening or closure. Note all AC values are given in RMS values.
- (6) Display: The set shall provide a display of the output voltage, current, and phase angles. The display will remain active when the set is under automatic computer control.
- (7) Compliance Voltage: The set's current sources shall have a high VA rating to test high impedance ground overcurrent relays (IRD) and voltage

operated bus differential relays. Note all AC values are given in RMS values.

- (8) Programmable Automatic Relay Test System: The set shall be capable of automatic relay testing. The hardware interface between the set and the controlling computer shall consist of one or more of the following methods:
- a. RS-232, serial connection.
 - b. USB
 - c. Ethernet 10/100 Base T
 - d. Sync interface to additional test sets

All hardware necessary to connect from the set to a controlling computer using one or more of the above interfaces shall be provided. The minimum cable distance shall be at least six feet.

Software shall be configured to communicate with and control the following Protective Relay Test Sets as a minimum: Doble F6000 Series, Megger MPRT Series, Manta MTS-1710 and MTS-1720 Series and Omicrom CMC Series.

Software shall be provided to facilitate static, dynamic, and transient testing. Static testing shall consist of complete control of all test set quantities and the ability to change those necessary to test various types of relays. These relays include but are not limited to impedance relays, phase comparison relays, directional overcurrent relays, overcurrent relays, over and under voltage relays, differential relays, high impedance bus differential relays, and voltage or current negative sequence filter networks. Dynamic testing shall consist of the ability to control the output of the set on a cycle-by-cycle basis. There shall be multiple states for pre-fault, fault, and post-fault testing. Transient testing shall consist of the ability to produce power system waveforms from Digital Fault Recorder or Relay oscillography records, Electromagnetic Simulation Program, and Comtrade files. Logic output shall be programmable on sample-by-sample file or file channel. Logic input shall be capable of triggering a jump to a user-specified sample.

- (9) Battery Simulator: If required in the appendix, the battery simulator shall be capable of meeting or exceeding the detailed specification given in Subarticle 2b of this Division.

- (10) Analog Output Configuration: The test set shall be capable of the following configurations from a single box:
- Six voltage channels
 - Six current channels
 - Four voltage with four current channels

(11) Status Inputs: The set shall provide eight user selectable status inputs. A means to program system triggers by use of a Boolean logic expression shall be provided.

(12) Contact Outputs: The set shall provide six user selectable contact outputs.

B. DETAILED SPECIFICATIONS

NOTE: THE FOLLOWING DETAILED SPECIFICATIONS ARE ON A PER PHASE BASIS.

THE NUMBER OF PHASES NECESSARY IS GIVEN IN PART 1 OF THE GENERAL INFORMATION.

(1) Output Voltage:

(a) Rating:

Potential Source:

AC Voltage:

Continuous Rating: 150 VA at range maximums up to 300 Volts AC.

DC Voltage:

Continuous Rating: 150 VA at range maximums up to 300 Volts DC.

(b) Amplitude Accuracy: $\pm 0.5\%$ of output voltage.

(c) Phase Accuracy 0.2 degrees of desired phase angle.

(d) Noise: -80 db of range at 50.60 Hertz.

(e) Stability: Output stable in all four quadrants-load power factor from 1 to -1 through zero lead or zero lag.

(f) Frequency Resolution / Range: 0.001 Hz from 0.1 to 99.999 Hz with 1 Hz resolution up to 2 kHz.

(g) Harmonic Capability: Harmonics of Internal or Line Frequency up to 20th Harmonic.

- (h) Electrostatic Discharge Immunity: As per IEC 80 1A
- (i) Surge Withstand Capability: As per ANSI/IEEE C37.90.
- (j) Distortion: Low distortion sine waves; total harmonic distortion should not exceed 2% at 50/60 Hz. Typical value should not exceed 0.2%.

(2) Output Current:

(a) Rating:

AC Current:

Continuous Rating: 450 VA at range maximums up to 90 Amps AC.

Transient Rating (1.5 seconds): 675 VA at range maximums up to 180 Amps AC.

DC Current:

Continuous Rating: 450 VA at range maximums up to 60 Amps DC.

Transient Rating (1.5 seconds): 675 VA at range maximums up to 120 Amps DC.

- (b) Amplitude Accuracy: 0.5% of output voltage.
- (c) Phase Accuracy: 0.2 degrees of desired phase angle.
- (d) Noise: -80 db of range at 50.60 Hertz.
- (e) Stability: Output stable in all four quadrants-load power factor from 1 to -1 through zero lead or zero lag.
- (f) Frequency Resolution / Range: 0.001 Hz from 0.1 to 99.999 Hz with 1 Hz resolution up to 2 kHz.
- (g) Harmonic Capability: Harmonics of Internal or Line Frequency up to 20th Harmonic.
- (h) Electrostatic Discharge Immunity: As per IEC 80 1A
- (i) Surge Withstand Capability: As per ANSI/IEEE C37.90.
- (j) Distortion: Low distortion sine waves; total harmonic distortion should not exceed 2% at 50/60 Hz. Typical value should not exceed 0.2%.

(3) Digital Timer:

- (a) Senses dry contact closing.
- (b) Senses dry contact opening.
- (c) Senses application of AC or DC voltage.
- (d) Separate start and stop gates for timer control.
- (e) Timer shall have the capability of using inputs as state change triggers to provide total control of state transitions under dynamic and transient type testing.
- (f) Three Auto-ranging Digital Timers with 0-999.9 ms/sec/cycles range. Accuracy of timer should be: ± 0.01 % of reading;

(4) Contact Outputs:

The set shall provide eight user selectable dry contact outputs.

- (a) Input Voltage: 250 AC/DC
- (b) Switching Current: 0.5 Amps make/break
- (c) Response Time: 0.1 millisecond maximum pick up and drop out
- (d) Isolation: 500 Volts Peak

(5) Monitoring Circuit:

The set shall incorporate monitoring circuitry capable of giving an audible and visual indication of contact opening and closure.

- (a) Senses dry contact closing and closing
- (b) Senses application of AC or DC voltage.
- (c) Response Time: 0.1 millisecond maximum.

3. Programmable Automatic Relay Test System:

In addition to the specifications given under general specifications, the following requirements apply:

- (a) Shall be compatible with IBM compatible computers.
- (b) Shall operate under WINDOWS XP or higher operating systems.

- (c) Bidder shall furnish a list of relays with complete testing routines (minimum of 100 electromechanical relays) that will be furnished with software program.

List shall indicate relay type and originator or submitting organization.

- (d) Testing routines (relay Modules) must not need to be modified prior to starting

the automated testing routines.

- (e) Transient replay capabilities shall meet or exceed the ability to replay 256,000 16-bit samples of transient waveform coefficients per channel.

- (f) Test program shall be capable of executing static, dynamic, and transient tests consecutively without stopping to load data in-between.

- (g) The timer portion of the test set shall be capable of starting on any sample point of the transient record, for measuring relay operating time.

- (h) Software shall be capable of storing multiple transient conditions and long-term power swing simulations.

- (d) Software system that will control the system and provide database capability; store, retrieve, query, report, graphics and communications functions. Separate SQL server to ensure database integrity.

- (e) Database scalable for network access and shared use.

- (f) User customized relay test plans and test-results history.

- (g) Optional power system model to create realistic dynamic state tests.

- (h) Test activity reports that can be saved in MS Word document format.

- (i) Graphical data plots.

- (j) Windows Explorer style view of database tree, with Find function.

- (k) Easy-to-use menus with a choice of a menu bar and a tool bar for easy access to options and functions.

2. Battery Simulator:

- (a) DC voltage output selectable between 48, 125, and 250 volts.

- (b) Rating of at least 60 watts continuous, with high starting current capability.

- (c) Output voltage shall be within $\pm 10\%$ of rating at all ranges.

- (d) Selection of voltage and application can be controlled both manually and through the provided automated relay testing software.

- (e) 50/60 Hz ripple shall be less than 0.2% of reading.

- (f) Switching noise shall be less than 5% of reading, peak to peak up to 30 kHz.

3. Enclosure: High impact, molded, flame retarding ABS-suitable to withstand severe shock and vibration.

4. TRAINING

Training shall be provided for the following equipment at the customer location or vendor location:

1. Protective Relay Test Sets
2. Automatic Relay Test System

5. TRADE-IN

1. Southwestern Power Administration has the following Protective Relay Test Sets to trade-in:

<u>Three (3) Epoch 10</u>	<u>Three (3) Epoch 20</u>	<u>Two (2) Epoch 40</u>	<u>Two (2) Pulsars</u> <u>With 3 voltage &</u> <u>3 current units each</u>
S.N.60696-001/2	S.N.85838-002/1	S.N.81006-002/1	S.N. 98199-001/1
S.N.60696-001/3	S.N.136591-001/1	S.N.93467-002/1	S.N.126042-001/1
S.N.85838-001/1	S.N.93467-001/1		
One (1) Epoch –II S.N.48091-003/1			

2. Trade-in prices shall be stated in the quotation.

ADDITIONAL GENERAL CONDITIONS

1. **Warranty:** The Contractor shall provide its standard commercial warranty or a warranty for a period of one year (whichever is greater) after final payment for all protective relay test sets that all equipment, materials, and workmanship of all protective relay test sets shall be free from defects.
2. The Contractor shall repair or replace, F.O.B. contract delivery point, all such defective equipment, materials, or workmanship.
3. Bidders will supply a list of users of the Protective Relay Test Set and the PC based Protective Relay Set software for automated testing of relays that are being bid.
4. The Government reserves the right to conduct on-site visits for demonstration to ensure products offered comply with agency requirements. A factory acceptance test will be performed with a System Meter/Relay Craftsman from Southwestern Power

Administration present to witness and verify that the Protective Relay Test Set represented has enough VA using three (3) current modules to test an IRD relay using the relay manufacturers instruction book as the procedure for the test. The acceptance test will not be performed on Southwestern Power Administration properties.